PHYSIOGRAPHIC CONTROLS ON MAST SEEDING IN A SEMI-ARID CONIFER, PINYON PINE (Pinus edulis)

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Research Questions:
How do climatic, physiographic, and edaphic gradients influence seed cone production in P. edulis?
What conditions promote successful mast seed events in P. edulis?

Framework
Widespread regional mortality events¹ and documented declines of cone production² have raised questions regarding the sensitivity of reproduction dynamics to global climate change in this mast-seeding conifer: a keystone species in southwestern, semi-arid woodlands.

Previous research has demonstrated that cone production exhibits a negative relationship with late summer temperatures³, suggesting a possible weather-related cue to initiate mast events.

Trends of increasing temperature and water stress may significantly influence reproductive output of P. edulis by altering resource availability³, disrupting pollination phenology³, and altering cues that initiate mast-seeding events¹,².

Field Work
30 sites in Western Colorado and New Mexico (Fig. 1)
• Latitudinal range of P. edulis
• Elevation range of 4800 – 8000 ft.
• Gradient of soil types, climates, slopes, aspects
Cone scar abscission methodology (Fig. 2)
Stand characterization

Fig. 1) Distribution of P. edulis (green) and study sites

Methods
• Monthly maximum temperature and mean precipitation data (via PRISM) for the 2 years prior to cone maturation was plotted against mean cone production at the tree-level using correlation matrices in R (Fig. 3).
• Red and blue bars denote the period of cone initiation in Y-2 and fertilization in Y-1.
• A linear model (mean cone production ~ elevation + latitude + average basal area) was built using the package lme4 in R.
• Partial residuals of elevation and latitude (Fig. 4 & 5) were plotted to visualize their relative contributing effects.

Results
• Cone production exhibits a positive relationship with elevation, and a negative relationship with latitude (R²=0.632, p<0.0003).
• Max summer temperatures showed the strongest, negative effects for both years prior to cone maturation.
• Precipitation exhibits strong positive effects on cone production during the summer following cone initiation (Y-2), and spring prior to fertilization Y-1.

Conclusions
• Results suggest both weather and physiography exert landscape-level controls over reproductive productivity.
• Consistent with previous research demonstrating negative relationship with cone production and late summer temperatures²,³, higher levels of productivity in high elevation stands³.
• Demonstrates sensitivity of cone production to annual fluctuations in local weather and physiographic gradients.

References